

Status of the Claims

5 1. (currently amended) A method for executing a software application in a plurality of computers computing nodes having respective node hardware resources said hardware resources comprising a respective memory and a respective I/O device, wherein said nodes computers include a first computer node and a
10 second computer node that intercommunicate over a network, and said nodes computers being operative to execute a virtual machine that runs under a guest operating system, comprising the steps of:

running at least a first virtual machine implementer and a second virtual machine implementer on said first computer node and
15 said second computer node, respectively using said respective memory; and

sharing said virtual machine between said first virtual machine implementer and said second virtual machine implementer using said respective I/O device in each of said first computer and said second computer to intercommunicate between said first computer and said second computer.

2. (currently amended) The method according to claim 1, further comprising the step of running said software application over said guest operating system, so that commands invoked by said software application are monitored or emulated by said first

virtual machine implementer and said second virtual machine implementer on said first computer node and said second computer node, while said node hardware resources of said first computer node and said second computer node are shared by communication over said network.

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3. (original) The method according to claim 1, wherein at least one of said first virtual machine implementer and said second virtual machine implementer is a virtual machine monitor.

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4. (original) The method according to claim 1, wherein at least one of said first virtual machine implementer and said second virtual machine implementer is an emulator.

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5. (currently amended) The method according to claim 1, wherein at least said first computer node comprises a first virtual node comprising a first physical CPU of said first computer node and a second virtual node comprising a second physical CPU of said first computer node.

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6. (original) The method according to claim 1, wherein said virtual machine comprises a first virtual machine and a second virtual machine, wherein said first virtual machine and said second virtual machine have a plurality of virtual CPU's that are virtualized by said first virtual machine implementer based on a first physical CPU and said second virtual machine implementer based on a second physical CPU, respectively.

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7. (original) The method according to claim 6, and a first virtual node comprises said first physical CPU and said second physical CPU.

5 8. (original) The method according to claim 7, wherein said first virtual machine implementer virtualizes at least one of said virtual CPU's of said first virtual machine based on said first physical CPU and virtualizes at least one of said virtual CPU's in said second virtual machine based on said second physical CPU.

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9. (currently amended) The method according to claim 1, further comprising the steps of:

providing a management system for said first virtual machine implementer and said second virtual machine implementer to control
15 said first computer node and said second computer node, respectively, wherein said management system comprises a wrapper for receiving calls to a device driver from said first virtual machine implementer, said wrapper invoking said device driver according to a requirement of said first virtual machine
20 implementer.

10. (currently amended) The method according to claim 9, further comprising the step of providing a virtual PCI controller for said management system to control a physical PCI controller in
25 one of said nodes computers.

11. (currently amended) The method according to claim 9, further comprising the step of providing a virtual DMA controller

for said management system to control a physical DMA controller in one of said ~~nodes~~ computers.

12. (currently amended) The method according to claim 11,
5 further comprising the steps of:

providing a virtual PCI controller to control a physical PCI controller in one of said ~~nodes~~ computers; and

during a bootup phase of operation scanning a device list with
said virtual PCI controller to identify devices having on-board
10 DMA controllers.

13. (currently amended) The method according to claim 1,
further comprising the steps of:

with said first virtual machine implementer and said second
15 virtual machine implementer maintaining mirrors of a portion of
said respective memory that is used by said guest operating system
in each of said ~~nodes~~ computers;

write-invalidating at least a portion of a page of said
respective memory in one of said ~~nodes~~ computers; and

20 transferring a valid copy of said portion of said page to said
one computer node from another of said ~~nodes~~ computers via said
network.

14. (currently amended) A computer software product,
25 comprising a computer-readable medium in which computer program
instructions are stored, which instructions, ~~when read by a~~
~~computer,~~ cause a plurality of computers having respective
hardware resources, said hardware resources comprising a

respective memory and a respective I/O device ~~the computer~~ to perform a method for executing a software application in a plurality of computing nodes having node resources, wherein said nodes ~~computers~~ include a first computer node and a second 5 computer node that intercommunicate over a network, and said ~~nodes computers~~ being operative to execute a virtual machine that runs under a guest operating system, comprising the steps of:

running at least a first virtual machine implementer and a second virtual machine implementer on said first computer node and 10 said second computer node, respectively using said respective memory; and

sharing said virtual machine between said first virtual machine implementer and said second virtual machine implementer using said respective I/O device in each of said first computer 15 and said second computer to intercommunicate between said first computer and said second computer.

15. (original) The computer software product according to claim 14, wherein at least one of said first virtual machine 20 implementer and said second virtual machine implementer is a virtual machine monitor.

16. (original) The computer software product according to claim 14, wherein at least one of said first virtual machine 25 implementer and said second virtual machine implementer is an emulator.

17. (currently amended) The computer software product according to claim 14, wherein at least said first computer node comprises a first virtual node comprising a first physical CPU of said first computer node and a second virtual node comprising a second physical CPU of said first computer node.

18. (original) The computer software product according to claim 17, wherein said virtual machine comprises a first virtual machine and a second virtual machine, wherein said first virtual machine and said second virtual machine have a plurality of virtual CPU's that are virtualized by said first virtual machine implementer based on said first physical CPU and said second virtual machine implementer based on said second physical CPU, respectively.

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19. (original) The computer software product according to claim 18, wherein said plurality of virtual CPU's that are virtualized by said first virtual machine implementer based on said first physical CPU and said second virtual machine implementer based on said second physical CPU, respectively.

20. (original) The computer software product according to claim 18, wherein said first virtual node comprises said first physical CPU and said second physical CPU.

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21. (original) The computer software product according to claim 20, wherein said first virtual machine implementer virtualizes at least one of said virtual CPU's of said first

virtual machine based on said first physical CPU and virtualizes at least one of said virtual CPU's in said second virtual machine based on said second physical CPU.

5 22. (currently amended) The computer software product according to claim 14, wherein said computer is further instructed to perform the step of running said software application over said guest operating system, so that commands invoked by said software application are received by said first virtual machine implementer and said second virtual machine implementer on said first computer node and said second computer node, while said node hardware resources of said first computer node and said second computer node are shared by communication over said network.

15 23. (currently amended) The computer software product according to claim 14, further comprising the steps of:

 providing a management system for said first virtual machine implementer and said second virtual machine implementer to control said first computer node and said second computer node, respectively, wherein said management system comprises a wrapper for receiving calls to a device driver from said first virtual machine implementer and said second virtual machine implementer, said wrapper invoking said device driver according to a requirement of said first virtual machine implementer and said second virtual machine implementer.

25 24. (currently amended) The computer software product according to claim 23, further comprising the step of providing a

virtual PCI controller for said management system to control a physical PCI controller in one of said computers nodes.

25. (currently amended) The computer software product
5 according to claim 23, wherein said computers computer is are further instructed to perform the step of providing a virtual DMA controller for said management system to control a physical DMA controller in one of said computers nodes.

10 26. (currently amended) The computer software product according to claim 25, wherein said computers computer is are further instructed to perform the steps of:

providing a virtual PCI controller to control a physical PCI controller in one of said computers nodes; and

15 during a bootup phase of operation scanning a device list with said virtual PCI controller to identify devices having on-board DMA controllers.

27. (currently amended) The computer software product
20 according to claim 14, wherein said computers computer is are further instructed to perform the steps of:

with said first virtual machine implementer and said second virtual machine implementer maintaining mirrors of a portion of said respective memory that is used by said guest operating system in each of said computers nodes;

25 write-invalidating at least a portion of a page of said respective memory in one of said computers nodes; and

transferring a valid copy of said portion of said page to said one computer node from another of said computers nodes via said network.

5 28. (currently amended) A computer system for executing a software application, comprising:

10 a plurality of computing nodes computers having node resources respective hardware resources, said hardware resources comprising a respective memory and a respective I/O device, said plurality of computing nodes computers comprising at least a first computer node and a second computer node;

15 a network connected to said first computer node and said second computer node providing intercommunication therebetween;

20 said first computer node and said second computer node being operative to execute a first virtual machine implementer and a second virtual machine implementer respectively using said respective memory, wherein a virtual machine is implemented concurrently by at least said first virtual machine implementer and said second virtual machine implementer; and

25 said computers nodes being operative to execute a guest operating system over said virtual machine, wherein said software application executes over said guest operating system, so that commands invoked by said software application are received by said first virtual machine implementer and said second virtual machine implementer on said first computer node and said second computer node, while said node hardware resources of said first computer node and said second computer node are shared by communication over said network using said respective I/O device.

29. (original) The computer system according to claim 28,
wherein said software application comprises a first software
application and a second software application, said guest
5 operating system comprises a first guest operating system and a
second guest operating system, and said virtual machine comprises
a first virtual machine and a second virtual machine, wherein said
first software application and said first guest operating system
are associated with said first virtual machine, and said second
10 software application and said second guest operating system are
associated with said second virtual machine.

30. (currently amended) The computer system according to
claim 29, wherein one of said computers nodes has a first physical
15 CPU and a second physical CPU, and said first virtual machine
implementer virtualizes a first virtual CPU in said first virtual
machine based on said first physical CPU and virtualizes a second
virtual CPU in said second virtual machine based on said second
physical CPU.

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31. (currently amended) The computer system according to
claim 28, wherein at least said first computer node comprises a
first virtual node and a second virtual node.

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32. (currently amended) The computer system according to
claim 31, wherein said first computer node comprises a first
processor and a second processor, a first I/O device and a second
I/O device, wherein said first I/O device is assigned to said

first processor, and said second I/O device is assigned to said second processor.

33. (currently amended) The computer system according to
5 claim 28, further comprising a minimal operating system executing
in each of said computers nodes to invoke said first virtual
machine implementer and said second virtual machine implementer so
that said first virtual machine implementer and said second
virtual machine implementer control said computers nodes.

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34. (currently amended) The computer system according to
claim 28, further comprising a management system for said first
virtual machine implementer and said second virtual machine
implementer to control said first computer node and said second
15 computer node, respectively, wherein said management system
comprises a wrapper for receiving calls to a device driver from
said first virtual machine implementer and said second virtual
machine implementer, said wrapper invoking said device driver
according to a requirement of said first virtual machine
20 implementer and said second virtual machine implementer.

35. (currently amended) The computer system according to
claim 34, further comprising a virtual PCI controller for said
management system to control a physical PCI controller in one of
25 said computers nodes.

36. (currently amended) The computer system according to
claim 34, further comprising a virtual DMA controller for said

management system to control a physical DMA controller in one of said computers nodes.

37. (currently amended) The computer system according to
5 claim 28, further comprising a memory management system ~~executing in at least one of said nodes~~ that maintains mirrors of a portion of said respective memory that is used by said guest operating system in each of said computers nodes, wherein said memory management system write-invalidates at least a portion of a page
10 of said respective memory in one of said computers nodes; and transfers a valid copy of said portion of said page to said one computer node from another of said computers nodes via said network.

15 38. (new) The method according to claim 1, wherein said guest operating system consists of exactly one instance of a single guest operating system.

39. (new) The computer software product according to claim 14,
20 wherein said guest operating system consists of exactly one instance of a single guest operating system.